Technical requirements for vehicle parts during design type testing pursuant to Section 22a of the Road Traffic Licensing Regulations (Straßenverkehrs-Zulassungs-Ordnung – StVZO)

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Notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services (OJ L 241, 17.9.2015, p. 1).

Part 1 General provisions

TR No 1: Procedure and transitional provisions

(1) The technical requirements apply to the testing of vehicle parts which, in accordance with Section 22a of the StVZO, must be of an officially approved design type.

(2) The Federal Motor Transport Authority (Kraftfahrt-Bundesamt) may deviate from the technical requirements if road safety permits it and technical development requires it.

In such cases, the expert opinion of the technical service must include a detailed technical description accompanied by a documentation containing all aspects relevant to the approval as well as a detailed description and justification of the deviations.

The Federal Motor Transport Authority may also recognise tests carried out and certified by the competent testing centres of other Member States of the European Union or Member States of the European Economic Area.

(3) Transitional provisions

- After publication of amendments to the relevant technical requirements in the Traffic Gazette (Verkehrsblatt), the Federal Motor Transport Authority may still issue vehicle part type approvals affected by them for up to three years and addenda to relevant vehicle part type approvals already issued before publication for up to three years on the basis of the latest version of the technical requirements.
- Technical requirements Nos 1 to 5 shall also apply to type approvals under other technical requirements with the date of publication of the relevant amendments or revised versions of the technical requirements Nos 1 to 5.
- The holder of the type approval may no longer place vehicle parts on the market three years after the publication of amendments to the technical requirements in the Traffic Gazette if these vehicle parts no longer comply with the current valid status following the publication of amendments to the applicable or approval-relevant technical requirements.
- In so far as the vehicle parts to be produced are intended exclusively as spare parts for vehicles already in use, the Federal Motor Transport Authority may issue a type approval for vehicle parts on the basis of the version of the technical requirements applicable to the original type approval. Such type approvals may, according to this original status, be extended by means of an addendum. The applicant shall indicate the status and, if known, the type approval valid at that time. For the purposes of these transitional provisions, spare parts are goods installed in or attached to a vehicle to replace original parts of that vehicle, including goods necessary for the use of the vehicle, with the exception of fuel.

- The type approvals issued for replaceable light sources in accordance with TR No 6 as published on 29.2.1980 (Traffic Gazette [VkBl.] p. 378) remain valid. The production monitoring requirements on which the type approval is based continue to apply.

(4) The technical requirements shall be mandatory at the latest 6 months after publication.

TR No 2: General requirements

(1) The effectiveness of the vehicle parts should not be impaired more than unavoidable by weather or normal operational stress.

This must be ensured by design, material and workmanship.

(2) The test pieces must conform to the intended production. Each test piece must be fitted with all accessories necessary for installation or mounting in the normal operating position and for proper operation, unless otherwise specified in the test provisions.

Standard fixing devices and means, such as screws and nuts, are excluded from the specifications; if certain standardised means of fixing are required, they must be specified.

(3) The standards referred to in these technical requirements may be obtained from Beuth-Verlag GmbH, Burggrafenstr. 6, 10787 Berlin.

(4) The data required for certain vehicle parts may be affixed directly to the vehicle part instead of on a nameplate.

(5) If the photometric minimum or maximum values are not exceeded by more than 20 % during the verification of lighting devices in accordance with Section 9 of the Vehicle Parts Regulation, and this is not attributable to a change in the design, no objections will generally be raised; in this case, further samples may need to be taken.

(6) Requirements for installation and operating instructions:

In the case of lighting devices and where further technical requirements require installation and operating instructions, these must contain the information necessary for proper installation and operation, the area of use and application and any restrictions on use. Installation and operating instructions written in German must be submitted to the technical service for type testing and contain all the information necessary for the end-user.

Only clear and comprehensible graphics, drawings, etc. may be used.

If, according to the applicant, vehicle parts are not placed on the market by the manufacturer himself, but supplied to OEMs, an information sheet for installation and operation in German is sufficient. The information sheet must contain the information necessary for proper installation and operation.

In the case of lighting devices, the installation and operating instructions referred to in paragraph 1, if applicable, must at least properly describe or illustrate the following:

- The operating possibilities, including a description of the functions, and an illustration or a description of the possible switching modes and switching functions;
- how to recognise that an existing control device for energy storage has activated signalling and how it is to be handled by the user;

- that the function indicator light for a full beam function in the case of bicycle lamps must be installed in the field of vision of the rider looking forwards;
- if necessary, the maximum power that can be extracted from an external connection (e.g. for charging external equipment);
- that a stoplight function operated in conjunction with a bicycle dynamo is only available when the dynamo has sufficient power;
- that lighting devices with a higher power requirement may only be operated with a dynamo with a sufficiently high capacity, and the power requirements must be indicated;
- instructions on what to do in case of failure;
- installation, in particular with instructions for the ready-to-use installation or where installation in pairs is required;
- the adjustment of headlamps and tail lamps;
- the installation of retroreflectors and retroreflective devices;
- if light sources can be replaced, instructions for the replacement of these light sources.

Part II Test provisions

A Lighting devices

TR No 3: General terms and measurement conditions

Part Definitions and measurement conditions for lighting devices

(1) The definitions in UN Regulation No 48, 07 series of amendments, Supplement 1 with its series of amendments in force at the time of application for a type approval shall also apply to these technical requirements irrespective of the type or category of vehicle.

(2) Type definition

a. Type definition ‘lighting devices for motor vehicles and their trailers’

Lighting devices shall be of different types if they differ in the following characteristics:

- the characteristics of the optical system (light distribution, category of light source, etc.; different light intensity levels within a device are not affected by this, provided that the different light levels are an optional part of the approval);
- the licence holder (equipment manufactured by the same manufacturer under different trade names may be of the same type).

b. Type definition ‘lighting devices for bicycles and their trailers’

Lighting devices and their functions shall be of different types if they differ in the following characteristics:

- the characteristics of the optical system (light distribution, category of light source, etc.; different light intensity levels within a device are not affected by this, provided that the different light levels are an optional part of the approval);
- the licence holder (equipment manufactured by the same manufacturer under different trade names are of the same type).

(3) The ‘control device for energy storage’ generates an optical signal that lights up to indicate that the battery needs to be replaced or recharged.

(4) ‘State of charge indicator’ means a device providing information on the state of charge of the energy storage system.

(5) By way of derogation from UN Regulation No 48, 07 series of amendments, Supplement 1, paragraph 2.18, a ‘function indicator light’ is an optical signal (or equivalent) indicating whether a device is switched on and is operating correctly or not.

(6) The measuring distance for photometric measurements must generally be such that the law of dependence on the square of the distance applies.

By way of derogation, the measuring distance of headlamps must be

- 25 m in accordance with TR No 7 and TR No 8, and
- 10 m in accordance with TR No 23.

For retroreflectors and retro-reflecting devices, the measurement conditions are specified in paragraph (8) of this TR.

The receiver area must be within a square with a side length of 65 mm.

(7) Voltages and current:

- ‘Rated voltage’ means the voltage (in volts) indicated on the light source or device.
- ‘Test voltage’ means the voltage at the terminals of a light source or device for which the specified characteristics of the light source or device are designed and at which these values must be checked.
- ‘Test current’ means the current through the terminals of a light source or device for which the specified characteristics of the light source or device are designed and at which these values must be checked.

(8) By way of derogation from paragraph (1), for measurements on retroreflectors the following applies:

- ‘Illumination angle‘ means the angle between the axis of reference of the retroreflector and the straight lines connecting the reference centre to the centre of the light source. It is in a horizontal plane;
- ‘Observation angle‘ means the angle between the straight lines connecting the reference centre to the centre of the receiver and the light source. It is in a vertical plane;
- ‘Coefficient of luminous intensity (CIL)‘ means the luminous intensity of the reflected light in relation to the illuminance perpendicular to the direction of the incident light at the location of the retroreflector.

In addition, with regard to measurements on retroreflectors, Annex 4 to UN Regulation No 150, 00 series of amendments, Supplement 3 must be taken into account.

(9) Colour determination:

For the colours and colour limits of the lighting devices, the following shall apply:

- For headlamps (other than those according to TR Nos 8 and 23) and signal lights the specifications in paragraph 2.11.1 of UN Regulation No 48, 07 series of amendments, Supplement 1;
- for retroreflectors and retro-reflective materials (plates, stripes, spoke covers, rim rings, etc.) the specifications in paragraph 2.11.2 of UN Regulation No 48, 07 series of amendments, Supplement 1;
- for headlamps, in accordance with TR Nos 8 and 23, the specifications for the colour white according to ISO 6742-1: 2015 Annex B;
- for warning lights with blue flashing light the specifications in Annex 3 to UN Regulation No 65, 00 series of amendments, Supplement 12;
- for additional warning lights pursuant to Section 53a(3) StVZO and portable flashing lamps in accordance with TR No 16a, the specifications in UN Regulation No 48, 07 series of amendments, Supplement 1, point 2.11.1;
- for warning lights with red light the specifications of UN Regulation No 48, 07 series of amendments, Supplement 1, point 2.11.1.

The provisions apply to all beam directions of a headlamp, a light or a retroreflector.

Part Definitions and measurement conditions for lighting devices on motor vehicles and their trailers as well as the light sources to be used with the corresponding test conditions

(1) Light sources:

(a) In the case of replaceable light sources, the following applies:

Any category of a light source approved in accordance with the requirements of UN Regulation No 37 or UN Regulation No 99 or UN Regulation No 128 or which is officially approved in accordance with Section 22a StVZO may be used, provided that, with regard to the intended use of each light source category (or categories)

- nothing is specified in the detailed provisions; or
- there are no restrictions on use in the relevant data sheets in Resolution R.E. 5, including all revisions in force at the time of the application for an authorisation; or
- there are no restrictions on use in the approval documents.

Furthermore, the following applies:

- The construction of the device must be such that the light source cannot be used in any other position but the correct one.
- For light sources listed in IEC Publication 60061, the light source base must comply with the specifications in IEC Publication 60061. The specifications of the base data sheet for the relevant category of light sources shall apply;
- The device shall be considered acceptable if, when tested with at least one standard lamp, it meets the requirements which may be submitted with the device.

For the replacement of a light source, the following must be taken into account:

The replacement of replaceable light sources and light source modules must be feasible:

- easily and without expertise,
- within a reasonable time,
- without special tools (except if supplied by the vehicle manufacturer as an on-board tool),
- in accordance with the replacement instructions supplied with the vehicle (in the on-board manual);
- under normal transport area conditions (excluding lifting platform or pit),
- without damage or injury (without sharp edges and burrs in the replacement area);

- with installed headlamps and lights, or in the case of removed headlamps and lights, if these are removed and reinstalled in accordance with the conditions specified above

.

(b) In the case of non-replaceable light sources, the following applies:

- Non-replaceable light sources must be an integral part of the lighting devices.
- In the case of non-replaceable filament lamps or light source modules with non-replaceable filament lamps, a report (by the light source manufacturer specified in the type approval documentation) must demonstrate that these non-replaceable filament lamps meet the durability requirements and, in the case of colour-coated filament lamps, also the colour fastness requirements set out in point 4.11. of IEC 60809, Edition 3.

(2) Measurements

(a) Lighting devices on vehicles equipped with replaceable light sources

All photometric measurements to be performed out with a rated supply voltage of 6 V, 12 V or 24 V, and unless otherwise specified in the detailed provisions, must be carried out with the corresponding reference luminous flux.

All colorimetric and photometric measurements are for vehicles must be performed with a rated supply voltage of 6 V, 12 V or 24 V:

- for lights accordingly with 6.75 V, 13.5 V or 28.0 V;
- for headlamps accordingly with 6.3 V or 13.2 V or 28.0 V respectively.

If the rated supply voltage for the lighting device deviates from this, all photometric and colorimetric measurements for lighting devices must be carried out at a test voltage or test voltage range as specified by the manufacturer and corresponding to the supply voltage of the vehicle.

(b) Lighting devices on vehicles equipped with non-replaceable light sources

- All photometric measurements to be performed out with a rated supply voltage of 6 V, 12 V or 24 V, and unless otherwise specified in the detailed provisions, must be carried out with the corresponding reference luminous flux. All photometric and colorimetric measurements of signal lights with non-replaceable light sources must be performed with 6.75 V, 13.5 V or 28.0 V, unless otherwise specified in the detailed provisions.

- All photometric and colorimetric measurements of headlamps (dipped beam, full beam and fog lights with non-replaceable light sources must be performed with 6.3 V, 13.2 V or 28.0 V, unless otherwise specified in the detailed provisions.

If the rated supply voltage for the lighting device deviates from this, all photometric and colorimetric measurements for lighting devices must be carried out at a test voltage or test voltage range as specified by the manufacturer and corresponding to the supply voltage of the vehicle.

(c) In the case of a supply voltage range, the photometric and colorimetric requirements must be met over the entire supply voltage range.

(d) In the case of a special power supply system, the above test voltages must be applied to the input terminals of this power supply system (ballast). The manufacturer must provide the Technical Service with the special power supply systems that are necessary to supply these lights. This special power supply system is part of the approved lighting device.

(e) The photometric measurements of signal lights equipped with light sources other than filament lamps must be carried out after a burning period of one minute and after stabilisation or, alternatively, after 30 minutes. Photometric stability is considered to be achieved if the fluctuations of the photometric value are always less than 3 % over any fifteen-minute period or, alternatively, are always less than 1 % over any five-minute period. The light distribution of the lamp after a burning period of one minute must be calculated from the ratio of the measured values, preferably in the main distribution plane (HV) after one minute and stabilisation, or after 30 minutes. In both cases, the maximum and minimum photometric and colorimetric requirements must be met.

(f) The photometric measurements on motor vehicle headlamps must be carried out after a burning period of one minute and after stabilisation. Photometric stability is considered to be achieved if the fluctuations of the photometric value are always less than 3 % over any fifteen-minute period or, alternatively, are always less than 1 % over any five-minute period.

The following measuring points are used to determine the ratio of luminous intensity after one minute and after stabilisation (see TR 7):

- Dipped beam 25 R
- Full beam H – V

The luminous intensity values measured after one minute and photometric stabilisation must meet the minimum and maximum requirements.

In the case of devices designed to operate exclusively on a flashing basis, measurements may be made using this method in the intended blinking mode.

In the case of combined devices with differently coloured lamp parts, the scattered light of a different colour emitted from adjacent parts of the lamp may only be so weak that it can no longer be seen from a distance of 10 m in all beam directions; in the case of signal lights which are only temporarily switched on (e.g. stop or direction indicator lights), it is sufficient if scattered light of the type mentioned is not observed in the photometric angle ranges required for the light distribution.

Part 3 Definitions and measurement conditions for lighting devices on bicycles and bicycle trailers as well as the light sources to be used with the corresponding test conditions:

(1) Bicycle dynamos, which are subject to type approval, are generators that are used to supply electrical power to lighting devices and must be labelled accordingly.

For the purposes of these technical requirements, the following categories are distinguished:

- Non-positive and frictionally engaged dynamos are generators according to ISO 6742-4:2015, point 3.1., in which the rotor is connected to a drive roller applied to the wheel with a force by means of a pivot bearing.
- Interlocking dynamos are generators coupled or integrated to the hub or wheel according to ISO 6742-4:2015, point 3.2.
- Other dynamos, such as eddy current dynamos, are generators in which stator and rotor are mounted separately (e.g. the magnets mounted on the rim or in the wheel are the rotor and the stator is fixed to the fork). They are to be considered as induction dynamos like interlocking dynamos.

(2) In the case of replaceable light sources, the following applies:

Any category of a light source of an officially approved type may be used.

Measurements of lighting devices with replaceable light sources must be carried out using a standard lamp as defined in the relevant data sheet at test luminous flux.

(3) When non-replaceable light sources are used, the light sources must be an integral part of the lighting devices.

(4) Lighting devices for bicycles and bicycle trailers operating with an external power supply at DC voltage must be tested at a voltage of 6.0 V or 13.5 V (equivalent to a rated voltage of 6.0 V or 12.0 V) as declared by the manufacturer. If a voltage range is provided for the operation of a lighting device, this voltage range must include at least one of the above voltages at which the tests must be carried out. It must also be demonstrated that the specified minimum or maximum values are not fallen short of or exceeded over the entire voltage range.

These devices must be labelled in accordance with TR 4, Part 2, No 6.

(5) Lighting devices for bicycles with integrated energy storage devices must be tested at:

- the rated voltage of the energy storage device, or the maximum voltage of the energy storage device if different from the rated voltage;
- the voltage at which the control device lights up in accordance with TR 4 Part 2, No 7

(6) Headlamps for bicycles powered by a dynamo must be tested with an alternating current source to approximate the behaviour of a dynamo under load. The circuit of the alternating current source must be sinusoidal with a frequency of 50 Hz.

The value of the internal resistance Ri must be at least 100 ohms.

The measuring current as declared by the manufacturer must be set for the lighting device to be tested, depending on the power class in accordance with TR 4, Part 2(9). This measuring current must be within the measuring current range defined in Table 1, with the voltage at the lighting device to be tested may be in the range of 5.8 – 7.5 V.

If higher voltages occur, the lighting device must have an output intended to connect a tail lamp, the output voltage of which is limited to 7.5 V and capable of delivering at least 110 mA.

For photometric measurements of the headlamp, the tail lamp must be replaced by a resistance at this output with a resistance value of

- 120 ohms for a 1.5 W system and
- 60 ohms for a 3 W system

.

The measuring current used and the resulting voltage must be documented in the measurement report.

Lighting device	Measuring current/mA	
	1.5 W system	3 W system
Headlamp with connection for the tail lamp	250 ±25	500 ± 50

Table 1: Permitted measuring current with tolerances for headlamps

Additional functions must be tested and documented as specified by the manufacturer.

(7) Tail lamps for bicycles powered by a dynamo must be tested at a sinusoidal alternating voltage of 6.0 V at a frequency of 50 Hz and the current for the tail lamp to be tested must not exceed the value given in Table 2, depending on the power class according to TR 4, Part 2(9).

The current measured during the test must be documented in the measurement report.

Lighting device	Maximum permissible current/mA	
	1.5 W system	3 W system

Tail lamp	55	110

Table 2 Maximum permissible current for tail lamps

Additional functions must be tested and documented as specified by the manufacturer.

(8) By way of derogation from paragraph 6 or paragraph 7, if a lighting device is inseparably assembled with a bicycle dynamo due to its design, the tests according to the relevant TR shall be carried out using the current determined at 15 km/h, which must be documented in the measurement report.

TR No 4: Structural requirements for lighting devices

Part General construction requirements for vehicle parts:

(1) All optically effective parts and the parts important for their mounting or adjustment must be manufactured so that their position relative to each other is not determined by other intermediate parts. If the type requires a particular position of these parts relative to each other, their position must be secured. In the case of adjustable brackets, the prescribed performance of the device must be maintained over the entire adjustment range; this does not apply where special adjustment requirements are known, and not for surface-mounted rear fog lights, if their correct mounting position is clearly visible and permanently marked on the cover lens.

(2) The devices must be designed so that they are adequately protected against the ingress of dust and water in their normal operating position during normal use.

(3) Furthermore, the devices must be designed so that, despite the occurring vibrations, the characteristics prescribed by these technical requirements are maintained and their proper functioning is ensured.

This shall be deemed to be confirmed for lighting devices on bicycles if this condition is met during the test referred to in TR 5(5).

(4) Electrical connections must be durable and secure in operation.

(5) The surface of the optically effective cover lenses of the lighting devices must be so designed that dirt can be easily removed. This shall be deemed to be fulfilled if, after cleaning with a cloth, the required lighting effect is still present.

(6) If several devices are combined in one appliance, each device must comply with the requirements applicable to it.

(7) Covering inscriptions on the cover lenses of headlamps and lamps are not permitted; this shall not apply to mandatory inscriptions, third-party test marks and trademarks, provided that they do not unduly impair the lighting characteristics.

(8) In the absence of specific requirements, the photometric characteristics (e.g. luminous intensity, colour, visible luminous surface, etc.) of a lamp must not be intentionally altered during its operation.

- Exceptions are light-signalling functions according to UN Regulations 48, 53, 74 and 86 for which this is permitted.
- The direction-indicator lamps must be flashing lamps.

Part 2 Additional structural requirements for lighting devices and their electrical supply systems for bicycles and bicycle trailers

(1) TR No 4, Part 1(2) shall be deemed to have been complied with if:

- Lighting devices and dynamos meet the requirements of ISO 6742-4:2015 points 6.1.1. and 6.1.2.; and
- headlamps and tail lamps with their own battery or rechargeable energy storage device meet the requirements of ISO 6742-5:2015, points 6.1., 6.2. and 7.3.1. and 7.3.2

.

- By way of derogation from the requirements described above, the tests according to ISO 6742-4:2015 point 6.1.2. and ISO 6742-5:2015 points 6.2 and 7.3.2 must be carried out on headlamps and lights when switched on.

(2) TR No 4, Part 1(3) is deemed to have been complied with if the devices comply with the test requirements pursuant to TR No 5(5).

(3) Lighting devices and dynamos for bicycles must be designed and mounted in such a way that their position on the bicycle is neither self-adjustable nor easily adjustable when the bicycle is in use.

For testing, screws/nuts may be fastened with a maximum torque of 5 Nm. The test is carried out in accordance with TR No 5(5).

(4) Removable headlamps or lights must be designed so that they can be mounted to the bicycle by simple means in accordance with Part 1(1).

(5) If, in the case of headlamps or tail lamps equipped with more than one light source, the failure of one light source results in the fact:

- that the required conditions for the headlamp or tail lamp (without other functions) are no longer met, they must switch off automatically or not light up again after being switched off manually;
- that the required minimum conditions for the headlamp or tail lamp (without other functions) are still being met does not need to switch off automatically, provided that the failure of one of these light sources is indicated by a function indicator light
- This function indicator light must not exceed a luminous intensity of 0.1 cd (measured perpendicularly) when the function control is activated to the maximum. The visible luminous surface of the function indicator light must not exceed 6 cm².

(6) Headlamps and lights must be clearly and permanently labelled with the required nominal voltage of the supply unit.

In the case of a voltage range, only the range must be indicated (e.g. ‘4.8 – 48 V’) as well as other required labelling.

(7) Headlamps and tail lamps equipped with their own battery or rechargeable battery (hereinafter referred to as energy storage device) must:

- have a clearly visible control device for the energy storage device used, which must be activated during operation at the latest when the photometric conditions are still being met.
  This information must be provided from a new battery as declared by the manufacturer or a fully charged battery after at least five hours of lighting time. This requirement must be fulfilled without taking into account any additional functions that may be available and, if several power levels are available, with the lowest power consumption. 'Visible' means acting by a sufficient contrast with the immediate surroundings of the control device.

- continue to light up for at least 30 minutes after the energy storage control device has been activated. If several power levels are available, this requirement must be met with the lowest power consumption.

  The optical signal of this control device must light up to indicate the photometric characteristics that are no longer fulfilled.

  This control device for energy storage devices may, in addition, flash briefly three times when switching on and in defined
  intervals depending on the state of charge of the energy storage device

  .

(8) Devices that contain voltage-limiting devices must be labelled with the following symbol (see figure below):

Figure 1.

They may only become effective under load above the test voltage.

The DC value corresponds to the effective value of the AC voltage.

(9) Lighting devices with an external power supply must meet the lighting requirements either with DC and AC voltage or with only one voltage type.

In the case of DC voltage, the polarity must be indicated if necessary.

If they can only be operated with one type of voltage, they must be labelled with the symbol for DC operation (see figure below),

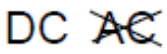

Figure 2.

or for AC operation (see figure below)

Figure 3.

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Devices for AC operation must be labelled with an indication of the power class for which they are intended.

The power class

- 1.5 W sys indicates devices powered by an alternator with a minimum of 1.5 W, and
- 3 W sys indicates devices powered by an alternator with at least 3 W

.

(10) A charging function or socket for external devices with appropriate cover may be provided on condition that there is a charging control limiting the charging current when the activated dipped-beam headlamp according to TR 23 and the tail lamp according to TR 14b are no longer adequately supplied. This must be demonstrated by the applicant to the technical service responsible for the approval test by appropriate documentation.

(11) A lighting device powered by an alternator may have a connection for an external battery supply, provided that there is an automatic switching function to ensure that the activated dipped-beam headlamp according to TR 23 and the tail lamp according to TR 14b are adequately supplied.

The correct operation of an automatic switching function must be checked with a discharged battery, which must be provided by the manufacturer.

(12) Headlamp adjustment:

Headlamps for bicycles shall be regarded as correctly adjusted within the meaning of Section 67(3), second sentence, of the StVZO if a ‘cut-off’ line can be identified on a level road surface.

If this is not possible due to the light distribution of the headlamp, the beam must be inclined at least so that its centre can be identified on the ground 10 m from the front of the headlamp.

(13) Lighting devices which may only be installed in pairs must be installed symmetrically and at the same height. The left part seen in the direction of travel must be labelled ‘L’ and the right part ‘R’.

(14) Projections for signalling purposes (e.g. lines, patterns, symbols, surface lighting with contours, etc.) are not permitted.

(15) A ‘control device for energy storage’, a ‘function control device’ and a ‘state of charge indicator’ must not exceed a luminous intensity of 0.1 cd (measured perpendicularly) at maximum activation. The simultaneously visible illuminated areas of all the above-mentioned displays must not exceed 6 cm^2.

(16) A ‘control device for energy storage’, a ‘function control device’ and a ‘state of charge indicator’ may not flash unless otherwise specified in the technical requirements.

(17) A state of charge indicator may light up briefly several times when a button is pressed, depending on the state of charge of the energy storage device.

Part 3 Structural requirements concerning the stability of warning triangles and warning lights pursuant to TR 19 and additional warning lights pursuant to Section 53a(3) StVZO (TR 20)

Warning lights of the type described above must be stable.

In order to check the stability, the warning light must be placed on a horizontal base measuring 1.5 m x 1.2 m, the surface of which must consist of sandpaper of type P36 in accordance with the FEPA[1] specification 4312006. This surface must correspond to a roughness of HS = 0.5 mm ± 0.05 mm, the verification of which must be carried out in accordance with the method (so-called sand surface roughness) laid down in Annex 4 to UN Regulation No 27 (04 series of amendments of 9 October 2014).

The airflow must

- be homogeneous and free of turbulence;
- hit the UUT with a rectangular constant wind profile, with the nozzle boundary layer being peeled off at the measuring table by a flow divider plate;
- completely flow around the above-mentioned standing surface;
- have a flow field with at least 150 mm clearance around the UUT upwards and on both sides to the boundary layer of the unaffected flow.

In the case of a closed wind tunnel, the area in the direction of the flow field of the UUT must not exceed 5 % of the total area of the cross section of the wind tunnel.

It must not be possible for the UUT to be moved out of position by the airflow acting parallel to the standing surface with a dynamic stagnation pressure of 210 hPa (210 $N/m)^2$) (e.g. wind force 9), regardless of the position of the devices in relation to the airflow.

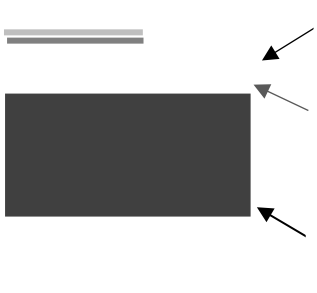
[1] FEPA: Federation of European Producers of Abrasives, 20 Avenue Reille, 75014 Paris, France.

Part 4 Structural requirements for removable warning lights:

(1) It must be demonstrated for all removable warning lights that they can be fitted to the vehicle in a simple manner if necessary.

Fastening devices must be designed so that:

- the reference axis marked on the lamp can be adjusted and locked parallel to the plane of the road surface and in that parallel plane in each required direction.
- Warning lights with magnetic supports are considered to be fixed if, when placed at an ambient temperature of 23 °C ± 5 °C on a metal plate of sufficient size (described in the figure below), their position does not shift by more than 200 mm at an acceleration of at least 16 g for 30 ms. The direction of acceleration must be horizontal.



Type of metal:	Steel with a yield strength Rp from 180 N/mm² to 240 N/mm²
Thickness:	$0,7^{+0,1}_{-0}$ mm
Radius:	≤ 5000 mm
Thickness of the colour application:	120 ± 20 µm
Scratch protection film:	Polyurethane
Thickness of the scratch protection film:	≥ 200 µm including glue

Figure 4. Metal plate with scratch protection

TR No 5: Structural tests

(1) The surfaces of the cover lenses of the lamps and of the retroreflectors must be resistant to exposure to a mixture of 70 % by volume of n-heptane and 30 % by volume of toluene. The surface, in particular the light-emitting surface, must be lightly rubbed with a cotton cloth soaked with the mixture. The surface is inspected after about five minutes. It must not show any apparent changes. However, slight surface cracks may be tolerated.

(2) Tests for the stability of the photometric characteristics with the headlamps switched on according to TR No 7 and TR No 8 must be carried out in accordance with Annex 7 to UN Regulation No 149, 00 series of amendments, Supplement 3.

(3) The tightness of retroreflectors whose retro-reflecting elements are not specular must be checked by immersing the whole retroreflector for 10 minutes into a water bath at 50 °C ± 5 °C so that the highest point of the upper part of the light-emitting surface is approximately 20 mm below the surface of the water. This test must be repeated after the retroreflector has been rotated by 180° so that the retro-reflecting optical unit at the bottom and its rear side is approximately 20 mm below the surface of the water. Both tests must be repeated immediately in water with a temperature of 25 °C ± 5 °C under the same conditions.

After this test, retroreflectors in which the retroreflector is glued or welded into a frame must be exposed to air at a temperature of 65 °C ± 2 °C for one hour and, after cooling to an ambient temperature, immersed for 10 minutes in a water bath at 25 °C ± 5 °C; the tests described in sentences 1 to 3 are then repeated.

If, after these tests, humidity appears on the rear side of the retro-reflecting elements or if water has obviously entered the retroreflector during a partial test, the device cannot be used.

(4) In the case of retroreflectors with a specular retro-reflecting side of the retroreflector, the specular covering must be protected against corrosion and mechanical damage. Protective coatings must be resistant to fuel.

The verification is carried out by brushing the rear side of the retroreflector with a brush with hard nylon bristles and by placing a cotton cloth soaked with the mixture referred to in TR No 5(1) on this side for one minute.

The cotton cloth is then removed and the retroreflector left to dry.

After evaporation, the rear side is rubbed again using the same nylon brush.

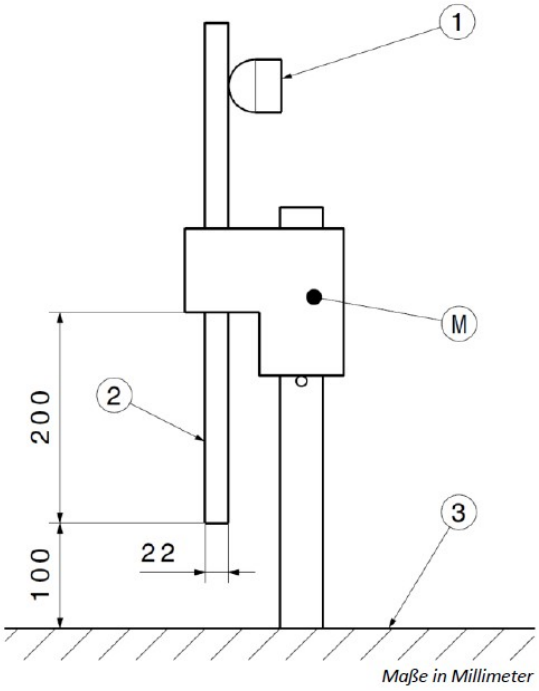
The coefficient of luminous intensity (CIL) must then be determined after the entire specular rear side has been covered with black ink.

In the case of lights, the cover lenses of which are connected to non-specular retroreflectors, the retroreflectors must be sealed by the rest of the lamp. Retro-reflecting devices, even if specular, must have a separate surround.

(5) Headlamps and tail lamps for bicycles and bicycle trailers shall be deemed sufficiently stable and firm if, after the following test, no damage is detected, the function remains ensured, the mounting position has not changed or shifted upwards or downwards by more than 3°.

The test must be carried out at an ambient temperature of 23 °C ± 5 °C.

The lighting devices must be fixed in accordance with the manufacturer's instructions (see figure below). The test fixture must be raised so that a distance of 100 mm between the contact surface and the lower end of the solid rod created. The test fixture must be relieved. The procedure must be repeated ten times.



1 UUT in mounting position (with bright chrome-plated tube, if necessary)

2 Solid rod

3 level concrete surface C20/25

M mass 15 kg with full rod, without UUT

Maße in Millimeter	Dimensions in millimetres

Figure 5. Test fixture (only symbolic)

The following notes should be taken into account during the test:

- Note 1. The mass of 15 kg does not include the mass of the lighting.
- Note 2. The mass of 15 kg and the height of 100 mm correspond approximately to an energy of 15 J.
- Note 3. A bright chrome-plated tube with dimensions according to the manufacturer's specifications must be used to which the lighting devices will be fixed.

TR No 6: Light sources

(1) The following requirements shall apply to light sources:
- UN Regulation No 37, 03 series of amendments, filament light sources, or
- UN Regulation No 99, 00 series of amendments, gas discharge light sources, or
- UN Regulation No 128, 00 series of amendments, LED light sources.

(2) For type approval according to this TR, 5 light sources must be submitted for testing.

Depending on the light source technology, the tests must be carried out according to the technical content of the UN Regulations referred to in paragraph 1.

(3) TR numbers 2 to 5 shall also apply to the design and testing, where applicable to light sources.

(4) For replaceable light sources, type-approved in accordance with Section 22a StVZO on the basis of the latest version of the technical requirements No 6, a new type approval in accordance with the above-mentioned requirement may be granted or an existing type approval may be extended if they are intended for use in lighting devices with national type approvals and if the approvals were granted in accordance with the latest version of the technical requirements, or in lighting devices with international type approvals if the approvals were granted prior to the entry into force of this version of the technical requirements.

TR No 7: Full-beam and dipped-beam headlamps and front fog lights for vehicles with a maximum design speed exceeding 45 km/h

(1) Full beam headlamps must comply with the requirements set out in point 5.1.;

Headlamps for an asymmetrical dipped beam must comply with the requirements set out in point 5.2.;

Headlamps for adaptive front lighting systems (AFS) must comply with the requirements set out in point 5.3.;

Headlamps for a symmetrical dipped beam must comply with the requirements for Class ES set out in point 5.4., and

Front fog lights must comply with the requirements set out in point 5.5.;

of UN Regulation No 149, 00 series of amendments, Supplement 3.

(2) For headlamps with plastic cover lenses

the tests of cover lenses or samples of material and of complete headlamps must be carried out in accordance with Annex 8 to UN Regulation No 149, 00 series of amendments, Supplement 3.

(3) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 8: Full-beam headlamps and dipped-beam headlamps for two-, three- and four-wheel vehicles with a maximum design speed not exceeding 45 km/h

(1) The full-beam and symmetrical dipped-beam headlamps must comply with the requirements for Class BS set out in UN Regulation No. 149, 00 series of amendments, Supplement 3, point 5.4.

(2) Optionally, the full-beam and dipped-beam headlamps may be reciprocally integrated or combined with a daytime running light function:

The daytime running light function must comply with either the light distribution as defined in UN Regulation No 87, Supplement 14 or UN Regulation No 148, 00 series of amendments, Supplement 3, point 5.4., or the minimum luminous intensities set out in the following table.

	Minimum luminous intensity in cd				
Angle	H = -10°	H = -5°	H = 0°	H = 5°	H = 10°
V = 10°	-	80	80	80	-
V = 5°	40	-	280	-	40
V = 0°	100	360	400	360	100

Table 3

The established maximum of 1 200 cd must not be exceeded.

The deactivation of the daytime running light function must be automatic and coincide with the activation of the dipped-beam headlamp. To this end, the conditions based on Annex 13 to UN Regulation No 48, 07 series of amendments, Supplement 1 must be taken into account.

(3) TR numbers 2 to 5 shall apply to the design and testing, where applicable to these headlamps.

TR No 9: Signal heads

(1) According to this TR, signal lights are

- Registration plate illumination
- Direction indicators
- Front position or tail lamps
- Stop lights
- End-outline marker lights
- Reversing lights
- Manoeuvring lights
- Fog lamps rear
- Parking lights
- Daytime running lights
- Side marker lamps

Signal lights must comply with the relevant requirements of UN Regulation No 148, 00 series of amendments, Supplement 3, point 5 for each device.

(2) For the design and testing the numbers 2 to 5 shall apply, where applicable to lighting devices for motor vehicles and their trailers.

TR No 13: Measurement conditions (general requirements) for warning lights

(1) The measurement conditions of this TR must be applied unless otherwise specified in the detailed provisions.

(2) Two samples for each colour must be submitted as test samples for one rated voltage as specified by the manufacturer, and, if necessary, two further samples for each other rated voltage if approval is applied for with different rated voltages. In this case, it is sufficient to carry out the tests in the applicable TR in accordance with Section 1, point 1.

(3) The definitions set out in UN Regulation No 65, 00 series of amendments, Supplement 11, points 1.3 to 1.5, 1.7 and 1.8 must be applied.

(4) The effective luminous intensity I_{eff} is a measure of the visibility and effectiveness of the flashing light (strobe light) of warning lights. The effective luminous intensity is defined in UN Regulation No 65, 00 series of amendments, Supplement 11, point 1.6.

(5) If the flashing light is generated from groups of flashes, the time interval Δt must be in accordance with point 6 of Annex 5 to UN Regulation No 65, 00 series of amendments, Supplement 11.

(6) For the assessment of double flashes, their cumulative effect shall be taken into account if their time interval is not greater than 0.04 s. If the interval is greater, only the flash with the higher maximum luminous intensity shall be assessed.

(7) The measurements required for the assessment of warning lights shall be made at an ambient temperature of + 23 °C ± 5 °C and at rated voltage (terminal voltage) unless otherwise specified in the specifications.

(8) The measurement distance must be chosen in such a way that the law of quadratic dependence on distance applies, but up to a maximum of 25 m.

(9) The warning lights with all the necessary components must still comply with the requirements of this TR after three hours of rated voltage at an ambient temperature of + 60 °C ± 5 °C.

(10) The warning lights must flash with a frequency of at least 2 Hz after one hour storage at -20 °C with a terminal voltage of 90 % of the rated voltage after 1 minute at the latest. The warning lights with all the necessary components must not show any visually noticeable changes after 12 hours of continuous operation.

(11) In filament lamp sockets, the filament lamp must rest on its reference plane. If gas discharge lamps or LEDs for which no general type approval has been granted are used to produce light flashes, they must be an integral part of the warning light so that the light source can only be replaced under the responsibility of the manufacturer of the warning light. If these non-replaceable light sources are used in conjunction with a light source module, this light source module must be labelled with the test mark of the warning light.

(12) All components necessary for the operation of the warning lights must form an integral part of the warning lights. If, by way of derogation, electrical assemblies are not an integral part of the warning light, they must bear the test mark of the warning light.

(13) The additional warning lights must be so designed that they can be firmly attached to the vehicle in the intended position. Adjustment devices shall not be permitted.

TR No 13b: Warning lights for red flashing light with only one main beam direction (stop signal)

(1) The additional warning lights must meet the following conditions, taking into account the general requirements for warning lights set out in TR No 13.

(2) Flashing frequency with terminal voltages between 90 % and 115 % of the rated voltages

- minimum 2 Hz
- maximum 4 Hz

(3) Colour

The colour of the emitted light is red, see TR No 3, Part 1(9)

(4) Bright period: Maximum 0.4/f.

(5) 'Off'-time: Minimum 0.4/f.

(6) Effective luminous intensity on the reference axis minimum 200 cd and maximum 600 cd.
Outside the reference axis, the effective luminous intensity in each direction must correspond at least to the percentage distribution relative to the minimum value on the reference axis H = V = 0° (100 %) (see figure below).

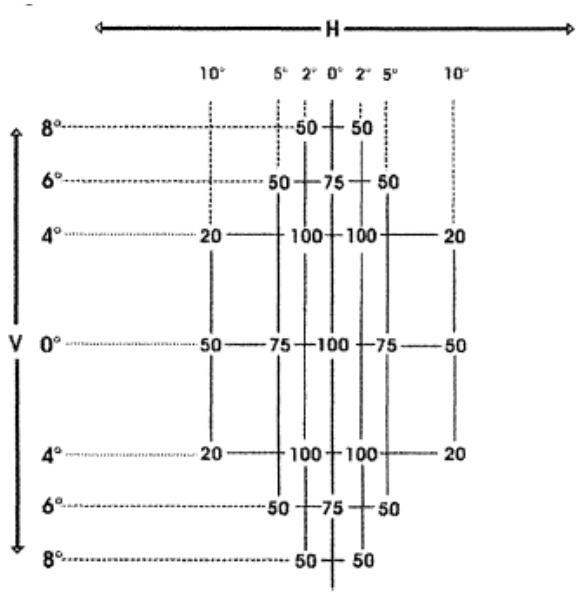


Figure 7.

(7) The measured lighting values must be measured in accordance with TR 3, Part 2(2). By way of derogation, for replaceable light sources, reference must be made to the minimum luminous flux. If this is not possible due to the absence of appropriate

specifications, these values must be determined at a voltage of 12 V applied to the connection terminals of the additional warning lights.

(8) Multiple flashing within the ‘on’-time is not allowed.

(9) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 14a: Front position lights for three- and four-wheel vehicles with a maximum design speed not exceeding 6 km/h and lamps for white light pursuant to Section 67a StVZO

(1) For the purposes of this regulation, lamps for white light in accordance with Section 67a StVZO are front position lights.

(2) Front position lights must comply with the photometric requirements of ISO 6742-1:2015, point 4.2.1.

(3) The colour of the emitted light is white.

(4) TR numbers 2 to 5 shall apply to the design and testing, where applicable to these lights.

TR No 14b: Tail lamps for three- and four-wheel vehicles with a maximum design speed not exceeding 6 km/h and for bicycles and bicycle trailers as well as lamps for red light pursuant to Section 67a StVZO

(1) For the purposes of this provision, lamps for red light in accordance with Section 67a StVZO are tail lamps.

(2) Tail lamps or lamps for red light pursuant to Section 67a StVZO must comply with the requirements of ISO 6742-1:2015, point 4.3.1. For this purpose, the tail lamps must be operated in accordance with TR No 3 Part 3 for the photometric measurements.

(3) In addition, the luminous intensity of 17 cd must not be exceeded in any direction. Furthermore, the maximum luminous intensity in the horizontal angular range of ± 165° to ± 180° and in a vertical direction to the front of the vehicle is limited to 0.25 cd from -2.5° to + 5°. The apex of the angle is the reference point.

(4) Tail lamps which, because of their installation, can be used only in pairs, must meet the requirements of paragraph 2, with each tail lamp meeting at least the requirements for the right or left side, respectively, 10° inwards and 110° outwards.

(5) In addition, they must emit red light with a luminous intensity of at least 0.025 cd upwards at least within an area in the form of a cone sector (see figure below). In the direction of travel, this area, represented by the horizontal cross-section A, is defined by the conus sector with the tip at the tail lamp with an angle of 30° to 45° and by the two radial sections running below 20° on either side of the direction of travel.

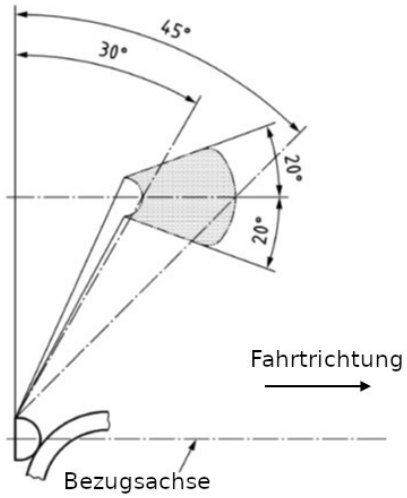


Figure 8.

Fahrtichtung	Travel sealing
Bezugsachse	Reference axis

In the case of tail lamps intended solely for operation by energy storage devices, upward emission is not required.

(6) They may have a parking light function, grouped or reciprocally incorporated with the tail lamp, which must comply with the requirements of ISO 6742-1:2015 point 4.8.1. In the case of tail lamps with a parking light function, the additional requirement of paragraph (5) above may be omitted if the same light source(s) is (are) used for the parking light function and the tail lamp.

(7) In addition, the tail lamp may be reciprocally incorporated with a stop light function as defined in UN Regulation No 50, 00 series of amendments, Supplement 16,point 7.

To this end, the tail lamp must be operated with the stop light function for the photometric measurements of the stoplight function as specified by the manufacturer.

The current measured during the test must be documented in the measurement report.

If this stop light function is operated in conjunction with a bicycle dynamo, the user manual must indicate that this function is only available when the dynamo has sufficient power.

The ratio of the actual measured luminous intensity of the tail lamp in operation with the stop light function to the luminous intensity of the tail alone must be at least 5: 1 in the area bounded by the straight horizontal lines passing through V = ± 5° and by the straight vertical lines passing through H = ± 10° of the light distribution pattern.

The stop light function must be activated either by electrical switches integrated into the bicycle braking system(s) or the tail lamp must include a device to switch on and off the stop light function if the following conditions are met. The method chosen must be documented in the technical description. The test of activation of the stop light function must be carried out with the tail lamp in the mounting position (or mounting positions) along the reference axis.

Conditions for activation and deactivation of the stop light function as specified in Table 4:

Linear acceleration	Stop light function	Activation time
At the latest at -1.0 m/s²	CN	≤ 0.5 s
less than -0.2 m/s²	OFF	≤ 1 s

Table 4

Activation with positive acceleration values > 0 m/s² is not permitted.

In addition, a tail lamp with a stop light function may also indicate emergency braking by means of an emergency stop light function.

For this purpose, the stop light function must be operated with a frequency of 4.0 Hz ± 1.0 Hz, under the activation and deactivation conditions described in Table 5. If several tail lamps are equipped with an emergency stop light function, they must flash synchronously.

Linear acceleration	Emergency stop light function	Activation time
At the latest at - 3.0 m/s²	CN	≤ 0.5 s
Less than - 2.2 m/s²	OFF	≤ 1 s

Table 5 Conditions for activation and deactivation of the emergency stop light function.

The stop light function and the emergency stop light function must not be activated by vibrations. This shall be deemed to be confirmed if these functions are not activated during the test pursuant to TR 5(5).

The correct functioning of the stop light function and the emergency stop light function must also be ensured when the bicycle is in an inclined position. This shall be deemed to be confirmed if the conditions for the activation of these functions are met when the reference axis of the measuring apparatus is inclined by ± 10 %.

In addition, an installation/mounting position of the tail lamp deviating from the specifications of the manufacturer must not lead to the unintentional activation of the stop light or emergency stop light function.

For this purpose, it is sufficient for the test to be carried out without acceleration.

(8) The colour of the emitted light is red.

(9) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to tail lamps for three- or four-wheel vehicles with a maximum design speed not exceeding 6 km/h and for bicycles and bicycle trailers.

TR No 16: Lights for securing loads

(1) The luminous intensity of lights for securing protruding loads in accordance with Section 22(4) and (5) StVO for white lights for securing to the front and red lights for securing to the rear must be at least 2 cd up to vertical and horizontal angles of ± 20° to the axis of reference, at least 1 cd for vertical angles up to ± 10° and horizontal angles up to ± 30° and at least 0.5 cd for angles up to ± 45°.

The luminous intensity of the lights must not exceed 12 cd in any direction for lamps for red light and 20 cd for lamps for white light.
The white and the red light can be combined in one device.

(2) Light strips for lateral securing of (long) loads

The luminous intensity of the light strip must be evenly distributed over the entire length of the strip. In relation to a range of 0.25 m,

- the luminous intensity must be at least 0.2 cd vertically (and ± 5° horizontally) around the horizontal axis at any point of the strip.
- In addition, the luminous intensity must be at least 0.1 cd up to ± 45° horizontally and must not exceed 25 cd in any direction.
- Colour of the emitted light: Yellow

(3) Fastening devices must be designed in such a way that possible pendulum movements of the mounted lights parallel to the longitudinal axis of the vehicle, is limited to an angle of ± 30° to the vertical on the road surface.

(4) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 16a: Additional lateral light strips and portable flashing lamps and red and white warning markings to secure tail lifts pursuant to Section 53b(5) StVZO

Part Portable flashing lights for securing lifting platforms

(1) Portable flashing lamps for securing tail lifts used as flashing lamps for yellow light instead of the rear direction indicator lights referred to in Section 53b(5) StVZO must emit yellow flashing light (strobe light) or give the observer

the impression of flashing by means of a rotating light beam.

(2) In the case of lamps intended to be connected to an electrical connection permanently installed on the vehicle, the devices for generating the flashing light and the necessary connecting cables must be an integral part of the lamps. The cables must be sufficiently flexible and have a usable length of at least

2.5 m. The connection to the vehicle must be made by means of a plug connection in accordance with DIN ISO 4165. For the test of these lamps, the corresponding rated voltage must be applied at the cable entries.

(3) Battery-operated lamps must have an uninterrupted burning time of at least 8 hours at an ambient temperature of 23 °C ± 5 °C; for

lamps with a rechargeable battery intended to be connected to the on-board power system of the vehicle (DIN ISO 4165) a burning time of at least 4 hours is sufficient.

The voltage present on the battery under load is the measuring voltage for the photometric assessment of the lamps. The requirements specified in paragraph 10 must still be met for this measuring voltage.

The intended power source for the device must be indicated on each device by manufacturer and by type. The information must be consistent with appropriate designations on the power source.

(4) Replaceable light sources such as filament lamps or LED light sources must be used to generate the flashing light.

If gas discharge lamps or LED modules for which no general type approval has been granted are used to generate the flashing light, they must be an integral

component of the lamp so that the light source can only be replaced under the responsibility of the lamp manufacturer.

(5) (5) In the case of replaceable light sources, test lamps must be used at a rated voltage resulting from the design of the lamp by way of derogation from TR No 3, Part 2.

(6) The direction of the reference axis must be clearly recognisable to the user based on the design of the device or must be clearly visible and permanently indicated on the device.

(7) The measurements required for the assessment of the lamps must be made at an ambient temperature of + 23 °C ± 5 °C, unless otherwise specified in the specifications.

(8) The flashing frequency f is the number of flashes per second.

(9) The 'off'-time tD is the time between one flash and the next, or, in the case of groups of flashes, between the last flash of a group and the first flash of the next group, during which the luminous intensity of the flashing is less than the hundredth part of the maximum value Imax, but not greater than 10 cd.

(10) The portable flashing lamps must meet the requirements set out in paragraphs 11 to 15 below, taking into account the general requirements of paragraphs 3-9 and 11 and 12 of TR No 13.

(11) Flashing frequency with terminal voltages

between 90 % and 115 % of the rated voltages
minimum 2.0 Hz
maximum 4.0 Hz

(12) The colour of the flashing light must be yellow in accordance with TR No 3.

(13) 'Off'-time

at least: 0.10 s
not exceeding: 0.50 s

(14) The luminous intensity in the normal direction must reach at least the following values:

for lights with filament lamps: I = 50 cd
for lights with gas-discharge lamps: Ieff = 35 cd

The directions H = 0° and V = 0° correspond to the normal direction parallel to the installation surface of the lamp in the direction of the required visibility; they pass through the point of reference. The values given in the diagram indicate, for the various directions of measurement, the minimum values expressed as a percentage of the minimum axle value required for each lamp (direction H = 0° and V = 0°). Within the range of light distribution schematically represented by a grid, the light distribution should be essentially uniform, i.e. the luminous intensity in each

direction of a part of the range formed by the grid lines must correspond at least to the minimum value in percentage indicated on the grid lines limiting the relevant direction.

In addition, the luminous intensity in the range up to H = 80° to both sides and V = 15° upwards and 5° downwards must be as follows:

for lights with filament lamps: I = 0.30 cd
for lights with gas-discharge lamps: Ieff = 0.21 cd

Outside the reference axis, the effective luminous intensity in each direction must correspond at least to the percentage distribution relative to the minimum value on the reference axis H = V = 0° (100 %) as shown below.

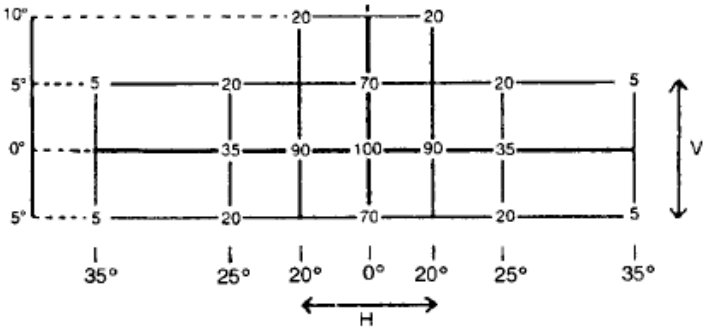


Figure 9.

(15) The luminous intensity of the lamps with circular action must correspond horizontally at least to those required for H = 0° in the above percentage distribution on the vertical axis.

Part 2 Additional lateral flashing strips

(1) Additional lateral flashing light strips are devices located on the sides of the tail lift and visible at least from the side. They may also emit light downwards in relation to the working position of the tail lift.
They must be mounted together with the flashing lights required under Section 53b(5) StVZO for tail lifts and as far outwards as possible on the tail lift.

The simultaneous activation of the flashing lights and the light strips may only occur when the tail lift is activated, but no later than as soon as an angle of opening of 30° is reached when the tail lift is folded down.

The device must be switched off when the tail lift is switched off or as soon as the corresponding angle of 30° is reached when closing.

The additional lateral light strips must emit warning flashing lights synchronously with the indicator lights during operation.

(2) Within an angular range of ± 10° vertically and ± 30° horizontally, the luminous intensity over the entire length must be at least 2 cd.

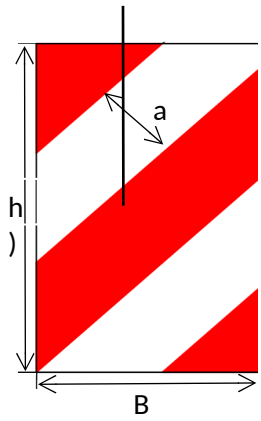
(3) The maximum luminous intensity must not exceed 25 cd in all directions in which light is emitted.

(4) Colour of the emitted light: Yellow.

(5) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

Part 3 Red-white warning marking

(1) Retro-reflecting surfaces with red and white stripes running outwards and downwards at an angle of 45° must be used as red and white warning markings to secure tail lifts. These surfaces must be fixed either flexibly or foldable under the tail lift. The effective part of these surfaces must be rectangular and designed as shown in the figure below.



Area for left-sided mounting;

the area for right-sided mounting is mirrored;

a = 92 ± 1 mm

b = 250 ± 5 mm

a = 400 ± 5 mm

Figure 10. Red and white warning markings

(2) The retro-reflecting effect of the stripes should be uniformly distributed over the stripes of the respective colours.

When illuminated with standard illuminant A (ISO 11664-2:2007(E)/CIE S 014-2/E:2006), the stripes in the colours white and red must achieve at least the coefficient of luminous intensity (CIL) in mcd/lx for the respective colour at each point, as summarised in Table 6 below.

Minimum CIL in mcd/lx				
With an observation angle of:	and a horizontal angle of illumination of:			
	± 5°		± 30°	
	red,	White	red ,	White
1/3°	50	360	20	200
1,5°	1.5	10	1	5

Table 6

(3) In order to eliminate a non-coloured surface reflection, the reference axis of the measuring surface must be rotated once in the plane of the observation angle until the surface reflection disappears. It shall be deemed to have been eliminated if it no longer appears in the range of the effective retro-reflecting elements.

The measuring surface used for the assessment must be a flat rectangle with a width of at least 80 mm and a size of at least 100 cm^2.

(4) The surface of the retro-reflecting material must comply with the requirements of TR No 5(1).

The surface must be such that dirt can be easily removed.

(5) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 18: retroreflectors for bicycles and bicycle trailers

(1) retroreflectors must have at least the following CIL as shown in the table below when illuminated with white light at the distribution temperature of 2 856 K and an illuminance of 1 lux after one hour storage in the open air at 65 °C ± 2 °C using the measuring arrangement specified in TR No 3, Part 1(8):

Observation angle	Illumination angle		Minimum CIL in mcd/lx for	
	horizontal	Vertical	(a) retroreflectors	(b) retroreflectors
α	β_H	β_V	for bicycles other than the retroreflectors pursuant to (b)	f. bicycles of category 'Z'
1/3°	0°	0°	300	1000
1/3°	0°	± 10°	200	700
1/3°	± 20°	± 5°	100	400
1,5°	0°	0°	5	30
1,5°	0°	± 10°	2.8	20
1,5°	± 20°	± 5	2.5	10

Table **7**

The CIL apply to retroreflectors in red colour and to pedal reflectors in yellow colour. For retroreflectors other than pedal reflectors, the minimum CIL given in Table 7 under (a) must be multiplied by a factor of 2.5 for yellow retroreflectors and by a factor of 4 for white retroreflectors.

These factors must also be taken into account in the series production of the yellow and white retroreflectors.

In the case of approval of retroreflectors in several colours,

- the CIL shall be tested only for the samples in red; and
- the colour shall be tested on all samples.

(2) Only that part of the light-emitting surface which is inside a circle of 200 mm in diameter must be used for the measurements; this surface must be limited to a maximum of 100 cm² and not more than 25 cm² in the case of spoke reflectors, without the surface of the retro-reflecting optical unit necessarily having to reach these dimensions; the manufacturer shall indicate the outline of the surface to be

used, with the maximum/smallest expansion ratio not exceeding 4 for retroreflectors.

By way of derogation from TR No 3, Part 1(8), the reference axis of the retroreflectors may deviate from the axis of reference of the lamp up to ± 5° in each direction if the retroreflector is part of a lamp.

In order to eliminate a non-coloured surface reflection, the reference axis of the retroreflector must be rotated once in the plane of the observation angle until the surface reflection disappears. It shall be deemed to have been eliminated if it no longer appears in the range of the effective retro-reflecting elements.

In the case of ambiguous mounting possibilities and in the case of spoke reflectors, the reflector must be rotated around the reference axis at the observation angle of 1/3° and the illumination angle of V = H = 0° until the lowest CIL is reached. Starting from this position of the angle of rotation, the minimum CIL specified in Section 1 must be complied with.

(3) Painted retroreflectors are not permissible.

(4) Retroreflectors must be specular if the retro-reflecting side of the retro-reflecting body is not tightly sealed, and must meet the requirements of TR 5(4).

(5) The tightness of retroreflectors must be verified in accordance with TR 5(3).

(6) Resistance to fuel must be in accordance with TR 5(1).

(7) ‘Z’ retroreflectors for bicycles in accordance with Section 1(b) of Table 7 must be clearly and permanently labelled with the letter ‘Z’ (minimum font height of 8 mm) on the light-emitting surface.

(8) The pedal reflectors must be positioned on the longitudinal sides of the pedal body or a plane parallel thereto in such a way that their reference axis is perpendicular to the pedal axis and parallel to the tread surface of the pedal body.

A separate fastening device or, in the absence thereof, the pedal itself, is part of the pedal reflector (by way of derogation from Section 7(4) of the Vehicle Parts Regulation) under the condition that the test mark is clearly legible and permanently affixed when installed.

If the construction of the pedal allows the retroreflectors to be replaced, they must have their own mount, even if they are specular.

The fastening of the pedal reflectors must be permanent and must not be able to come loose under normal conditions of use.

(9) Spoke reflectors must be designed in such a way that they can be mounted on the spokes of the front and rear wheels and that their reference axis is perpendicular to the longitudinal median plane of the vehicle. Deviations from this due to the

varying inclination of the spokes to the longitudinal median plane of the vehicle shall not be taken into account. The fastening of the spoke reflectors must be permanent and must therefore not be achieved solely by springing parts, but by special fastening elements, e.g. screws, bolts or brackets, which are not expected to become loose under normal conditions of use.

(10) These requirements shall also apply for retro-reflecting devices for distance warning devices, taking into account the minimum CIL set out in Table 7 under (a).

(11) For the design and testing the numbers 2 to 5 shall apply, where applicable to lighting devices for bicycles and bicycle trailers.

TR No 18a: Retroreflective devices on wheels of bicycles and bicycle trailers

(1) Retroreflective tyres must be designed in such a way that the two sidewalls are fitted with a continuous ring of retro-reflective material.

(2) Retro-reflective strips on tyres must comply with the requirements UN Regulation 88, 00 series of amendments, point 11.

(3) Retro-reflective strips on the rims of bicycles and their trailers must comply with the requirements UN Regulation 88, 00 series of amendments, point 11.

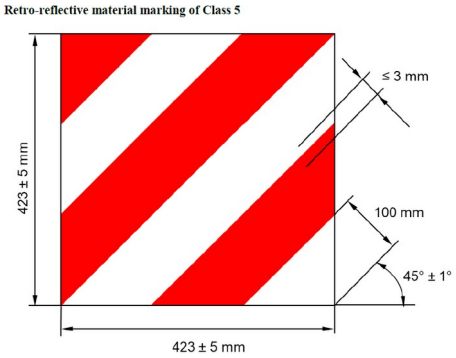
(4) Retroreflective spoke covers and spokes for bicycles and their trailers must meet the photometric requirements of Table 9 of ISO 6742-2:2015 when tested in accordance with the test requirements of ISO 6742-2:2015, point 8.4.

(5) The colour of the reflected light must be white or white/yellow in accordance with UN Regulation 88, 00 series of amendments, Annex 5.

(6) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for bicycles and bicycle trailers.

TR No 18b: Parking warning signs

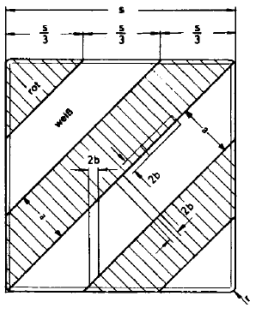
(1) Parking warning signs must be retroreflective and the effective part of the signs must have the shape of a square with the dimensions and characteristics shown in the following figure:



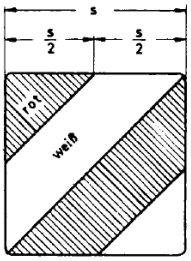
Maße in mm

	Form A	Form B
s	423 ± 5	282 ± 5
a	100	
b	≤ 3	
r	≤ 10	

Form A



Form B
a, c, r wie Form A



Form A	Type A
Form B	Type B
Maße in mm	Dimensions in mm
Form B a, c, r wie Form A	Type B a, c, r as type A

Figure 11.

(2) The retro-reflecting stripes may consist of reflective materials with a smooth surface or of retroreflectors and must comply with the requirements for Class 5 according to UN Regulation No. 150, 00 series of amendments, Supplement 3.

They may be composed of several non-replaceable parts. Non-retro-reflecting rectilinear interruptions between the adjacent retro-reflecting parts are permitted provided that they are not larger than 6 mm (2b).

These non-retroreflecting parts must be of the same colour as the corresponding retro-reflecting stripe; Where there are two adjoining stripes of different colours, the non-reflecting edge of each stripe must not exceed dimension b.

The warning sign may have a non-retroreflecting edge around the effective part and the corners must be rounded. Within the effective part, there must be up to twenty ineffective free spaces for fixing the sign or its parts, but they must not exceed a total area of 16 cm² and each individual free space must not exceed 4 cm². The free spaces must be distributed as evenly as possible on the sign.

(3) The warning signs must be fitted with a fastening device allowing proper attachment to the vehicle. The signs may be foldable if this does not impair the other required properties.

The non-retro-reflecting strip resulting from the use of a hinge must not exceed a width of 10 mm and is not counted towards the free spaces defined in paragraph 2.

(4) Removable signs must bear a high-contrast and clearly visible inscription identifying the side of the vehicle to which the sign must be applied when used.

(5) The surface of the retro-reflecting stripes must be resistant in accordance with TR No 5(1).

The surface must be such that dirt can be easily removed.

Painted retroreflectors and reflective materials are not permitted.

In addition, nine samples of the red retroreflective strip of the parking warning sign with a minimum size of 40 mm x 100 mm must be subjected to additional artificial weathering as follows:

Temperature and radiation resistance testing according to Annex 13 to UN Regulation No 150, 00 series of amendments, Supplement 3, until the contrast No 4 on the grey scale has been reached for test standard No 7.

After this test, the colour of the light reflected by the sample must not be changed and the required CIL for parking warning signs must be determined in accordance with Section 2.

This weathering must not alter the colour of the light reflected by the sample.

(6) If retroreflectors are used, they must be specular if the retro-reflecting side of the retroreflector is not tightly sealed. Retro-reflecting devices, even if specular, must comply with TR 5(5).

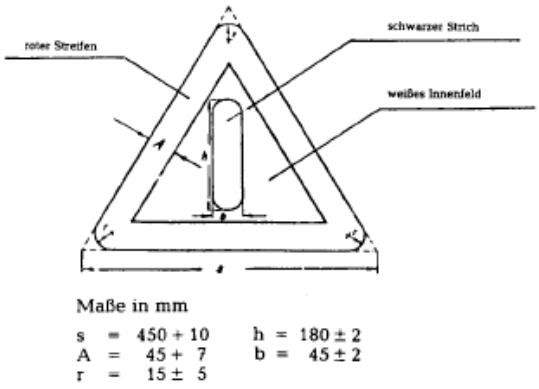
(7) The tightness of retroreflectors must be verified in accordance with TR 5(4).

(8) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 19: Warning triangles and warning lights

Part Warning triangles

(1) Warning triangles must have the shape of an equilateral triangle with dimensions and characteristics as shown in the following figure:



red stripe	red stripe
black line	black line
Dimensions in mm	Dimensions in mm
white inner section	white inner section

Figure 12.

The red stripe A of the triangle must be retroreflective over a width up to at least 41 mm. The retro-reflecting stripe may consist of retro-reflective materials with a smooth surface or of retroreflectors; it may be composed of several parts. Non-retro-reflecting rectilinear interruptions between the adjacent retro-reflecting parts are permitted provided that they are not larger than 12 mm. The inner section must be white and must not be retro-reflecting. The back of the triangle should also be white but not retroreflective; however, it may also be identical to the front side.

(2) The equilateral triangle referred to in paragraph 1 must be fitted with an easily operable installation device so that the triangle can be put up on the road in a safe manner (see also paragraph 5). There must be a clear distance of at least 50 mm between the lower edge of the triangle and the level surface on which it is placed. The angle between the triangle surface and the level surface on which it is placed must be at least 60° in the operating position.

The warning triangle may foldable if this does not impair the other required characteristics or unduly hinder the rapid installation.

(3) The retro-reflecting effect of the red stripe A must be uniformly distributed on the stripe over the prescribed width. When illuminated with white light with a distribution temperature of 2 856 K, the retro-reflecting effect, based on an area of 20 cm² at an observation angle of 1/3°, must achieve at least the values shown in the following table at every point:

CIL [mcd/lx]	In the case of an illumination angle of up to
250	± 5°
100	**± 30**°

Table 8

The measurement is based on the assumption that the reference axis is perpendicular to the base edge of the triangle and parallel to the level surface on which the triangle stands. The measuring surface used for the assessment must be a rectangle with a width of 41 mm and a size of at least 20 cm².

Where retroreflectors are used, the provisions for the material used shall apply mutatis mutandis to the red stripe A and the other triangular symbols in TR No 5, Sections 3 and 4.

(4) Tests for the stability of the photometric and colorimetric characteristics of retro-reflecting stripes with regard to weather resistance must be carried out in accordance with Annex 13 to UN Regulation No 150, 00 series of amendments, Supplement 3.

(5) The stability of the warning triangles must be tested in accordance with TR 4 Part 3.

Part 2 Warning lights

(1) Portable warning lights in accordance with Section 53a(1) StVZO that are independent of the lighting system of the vehicle must generate a yellow flashing light with an uninterrupted burning time of at least 15 hours at an ambient temperature of 23 °C ± 5 °C.

(2) The intended power source for the device must be indicated on each device by manufacturer and by type.

The information must be consistent with appropriate designations on the power source. It is only permissible to connect the warning light to the vehicle's lighting system if the device can be switched to independent operation and meets all the requirements of paragraphs 4 to 10.

(3) Warning lamps operated by non-renewable power sources must be fitted with an indicator that shows whether the power source used still has the capacity required for the minimum burning time specified in paragraph 1. For these devices, the burning time for determining the minimum burning time in accordance with paragraph 1 shall be counted from the time at which the indicator shows that the capacity is just sufficient.

If, after the prescribed minimum burning time has elapsed and the device has been switched off after a waiting period of 48 hours, the power sources recover to such an extent that the indicator device responds again in the sense of a corresponding reserve capacity, the determination of the burning time mentioned above is repeated. A comprehensible functional description of the indicator must be permanently affixed to each device so that it is legible from the outside.

(4) Where replaceable light sources are used, TR No 3, Part 2(1)(a) shall apply. A test lamp whose power consumption at test voltage does not deviate from the nominal value by more than ± 5 % must be used to determine the burning time, the flashing characteristics and to check the indicator.
Where non-replaceable light sources are used, TR No 3, Part 2(1)(b) shall apply.

(5) Flashing frequency with terminal voltages between 90 % and 115 % of the rated voltages

- minimum 1.5 Hz
- maximum 2.0 Hz

(6) Colour of the flashing light yellow

(7) Bright period

- minimum 0.08 s

(8) If a filament lamp is used as a light source, the light distribution of warning lights with its own power source must be determined by switching the filament lamp to continuous light instead.

Then, the luminous flux must reach at least 90 % of the luminous flux generated by the same filament lamp at the respective voltage with continuous light.

(9) The voltage still present at the battery under load after the minimum burning time of 15 hours when determining the burning time according to paragraph 3 is the measuring voltage for the photometric assessment of the lights. The requirements specified in the table in paragraph 10 must still be met for this measuring voltage.

The intended power source for the device must be indicated on each device by manufacturer and by type. The information must be consistent with appropriate designations on the power source.

(10) The luminous intensity measured in application of paragraph 4 must reach at least the values given in the following table:

	Within a horizontal angle, and on both sides of the normal direction		
Within a vertical angle of	**10°**	**20°**	**30°**
	A luminous intensity [cd] of		
±10°	**7**	**3**	**0.5**

Table 9

The normal direction is the direction in which the warning must be given under the circumstances. The direction must be clearly recognisable to the user based on the design of the device or must be clearly visible and permanently indicated on the device. This can only be waived if, within the vertical opening angle of 10°, the minimum luminous intensity required for horizontal angle up to 10° is achieved in each direction.

The required luminous intensity values must also be complied with within a 4-hour burning time if the burning time tests referred to in paragraph 3 are carried out at a temperature of -10 °C ± 2 °C. The frequency and switch-on duration of the flashing pulses must be within the limits set out in paragraphs 5 and 7.

(11) The installation devices must be an integral part of the warning lights. Warning lights may be foldable if this does not impair the other required characteristics and does not unduly hinder their rapid installation.

(12) The centre of the light must be at least 150 mm above the surface it stands on. The combination of portable warning lights with other lighting functions (e.g. repair lamps) is permitted if they have a device to prevent the burning of the additional lamp when the warning light is switched on.

(13) The stability of the warning lights must be tested in accordance with TR 4 Part 3.

(14) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 20: Additional warning lights pursuant to Section 53a(3) StVZO

(1) Additional warning lights are lights with an all-round effect.

The lamps are designed as removable warning lights installed on the outside of the vehicle.

Simple and clear operating instructions for the correct mounting and installation of the light must be provided by the manufacturer. The fastening devices must be an integral part of the light.

(2) The additional warning lights must meet the following conditions, taking into account the general requirements for warning lights set out in TR No 13:

(3) Flashing frequency with terminal voltages between 90 % and 115 % of the rated voltages:

- minimum 1 Hz
- maximum 4 Hz

(4) Colour of the flashing light: yellow

(5) 'Off'-time:

- minimum 0.10 s
- maximum 0.45 s

(6) Effective luminous intensity in a vertical angle of 0° and a horizontal angle of 360° around the axis of reference:

- minimum 50 cd
- max 500 cd

(7) Minimum value of the effective luminous intensity within the required vertical angles and a horizontal angle of 360° around the axis of reference

vertikal	mindestens
innerhalb ± 10°	50 cd
innerhalb ± 20°	12,5 cd
In keiner Richtung mehr als 500 cd	

vertical	at least

Within ± 10º	50 cd
Within ± 20º	12.5 cd
In no direction more than 500 cd	

Table 10

(8) The measured lighting values must be related to the minimum luminous flux of the light source. If this is not possible due to the absence of appropriate specifications for the light source, the lighting values must be determined at a voltage of 12.0 V applied to the connection terminals.

(9) The additional warning lights must be so designed that they can be firmly attached to the vehicle in the intended position. Adjustment devices shall not be permitted.

(10) The devices for generating the flashing light and, in the case of removable lamps, the necessary connecting cables for the connection permanently installed in or on the vehicle must be an integral part of the lamps. The cables must be sufficiently flexible and have a usable length of at least 2.5 m

(11) In the case of warning lights that can be attached to the outside of the vehicle as required and are independent of the vehicle's on-board power system, or warning lights that can be operated both independently of and dependent on the vehicle's on-board power system, the stability must be tested in accordance with TR 4, Part 3.

(12) Battery-operated lamps must have an uninterrupted burning time of at least 15 hours at an ambient temperature of 23 °C ± 5 °C; for lamps with a rechargeable battery intended to be connected to the on-board power system of the vehicle (DIN ISO 4165), a burning time of at least 8 hours is sufficient.

The voltage present on the battery under load is the measuring voltage for the photometric assessment of the lamps. The requirements specified in paragraph 6 or 7, respectively, must still be met for this measuring voltage.

The intended power source for the device must be indicated on each device by manufacturer and by type. The information must be consistent with appropriate designations on the power source.

(13) The warning lights operated at rated voltage with all the necessary components must still comply with the requirements of these technical requirements after a continuous operation of 3 hours at an ambient temperature of + 55 °C ± 5 °C and of 30 hours at an ambient temperature of + 23 °C ± 5 °C.

(14) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 22a: Lighting devices for self-illuminating registration plates

(1) Two samples of the lighting devices with the intended light sources must be submitted for the tests.

At the request of the applicant, it may also be indicated that the device may be fitted in more than one position or in a range of positions in relation to the space reserved for the registration plate.

These different positions must be indicated by the applicant in the information sheet.

The following must be attached to the application for each type:

a. Drawings ensuring the identification of the type with sufficient clarity and showing the geometrical conditions for the installation of the lighting device with reference to the mounting surface for the registration plate and the outline of the corresponding surface to be illuminated. See Part D of Annex 2 to UN Regulation No 148, 00 series of amendments, Supplement 3. The drawings must indicate the location intended for the approval mark.

b. A technical description indicating in particular the type and power consumption of the light sources intended by the manufacturer.

(2) Lighting devices for self-illuminating or transparent registration plates pursuant to Section 12(14) of the Vehicle Registration Regulation are lighting devices which:

- either shine through a transparent retroreflective registration plate, or

- form an inseparable unit with a retroreflective registration plate so that the inscription on the plate is backlit and/or illuminated.

(3) All photometric and colorimetric measurements must be made in accordance with TR 3, Part 2(2).

(4) The luminance must be measured on a circular measuring surface with a diameter of 25 mm perpendicular to the surface of the plate in accordance with the definition of the position of the measuring points shown in the diagram in Figures A3 IX to A3 XV of Annex 3 to UN Regulation No 148, 00 series of amendments, Supplement 3. These requirements must, where appropriate, be applied mutatis mutandis to other registration plate parameters referred to in Section 2(2) of the Ordinance on the Registration of Vehicles for Road Traffic (Fahrzeug-Zulassungsverordnung – FZV).

The luminance at each measuring point must be at least 2.5 cd/m² and must not exceed 25 cd/m². The illuminated surface must be homogeneously illuminated.

The ratio of maximum and minimum luminance, measured at any point within the field of measuring points in Figures A3 IX to A3 XV above, as defined in Section 3 of Annex 3 to UN Regulation No 148, 00 series of amendments, Supplement 3, must not exceed a factor of 4.0. In addition, the ratio between two

adjacent measurement points within the field of measurement points must not exceed a factor of 2.0.

In the case of registration plate lights forming a unit with a retroreflective registration plate, the luminance shall be measured on the finished unembossed unit.

In the case of lighting devices for transparent retroreflective registration plates, the luminance must be measured on the finished lighting unit (without registration plates) and the values obtained must be divided by 3 (corresponding to a required minimum transmittance of 33 %, see paragraph 4).

(5) Interfering reflections or refraction of light on parts of lamps (e.g. at the edge of the light emission openings) are not permitted.

(6) Manipulation of the luminance is not permitted. This does not apply to approved control systems that are only required to maintain luminance.

(7) Lighting devices for transparent registration plates must be designed in such a way that the emitted light is visible from all relevant directions of observation. This must be colourless enough to ensure that the colour of the registration plate is not significantly altered.

(8) Registration plate lights forming a unit with a retroreflective registration plate must comply with the requirements of DIN 74069:2022-10, and a corresponding expert opinion must be provided.

Deviations from DIN 74069:2022-10 which are due to the design or materials used and which cannot be tested according to the standard are permitted. The tests must then be carried out in accordance with the comparable requirements for lighting devices or materials in the standard. Corresponding expert opinions must be provided.

The transmittance of transparent registration plates must not be less than 33 %. For this purpose, a complete, transparent retroreflective registration plate must be tested for transmittance with a test device in accordance with DIN 5036 Part 3, edition November 1979. The diameter of the circular measuring surface must be 25 mm ± 1 mm. The measurements must be carried out over the entire surface at a distance of 25 mm to the edge of the registration plate, and no measured value may be below the specified minimum.

(9) The lighting devices for retroreflective registration plates must include all the components necessary for the operation of the relevant devices.

If, by way of derogation, electrical assemblies are not an integral part of the lighting devices for retroreflective registration plates, all components must bear the test mark of the lighting devices of the retroreflective registration plates.

(10) If an operating voltage > 42 V is used within the lighting device, the structural design must be such that damage to persons caused by the intended use and/or by the effects of normal stresses during operation is excluded. With regard to electromagnetic compatibility, Directive 72/245/EEC, as amended, must be applied.

(11) Lighting devices with registration plates and their combinations must be protected against ingress of water and foreign bodies and comply with ingress protection

IP5K9K according to ISO 20653:2013. Accordingly, the required lighting effect must not be unduly impaired.

(12) Registration plate lights and their attachments must not obscure the registration plate in its prescribed size up to an angle of observation of at least 5° above a plane running parallel to the road through the observation point.

(13) In addition to the requirements of paragraph 4 above, in case of a transparent registration plate, the complete registration plate and/or the lighting devices forming a unit with the retroreflective registration plate must be subjected to the light and weather resistance test in accordance with point 5.6 of DIN 74069, edition July 1996. Lighting devices forming a unit with the retroreflective registration plate must be put into operation during the specified dark phase.

In addition to the above requirements, transparent retroreflective registration plates must meet the weathering requirements set out in point 5.3.5 of DIN 74069, edition July 1996. In the case of lighting devices forming a unit with the retroreflective registration plate, after the weathering, the luminance must not have decreased by more than 5 % compared to the value measured prior to weathering.

(14) Lighting devices according to TR 22a retain their type approval, even if, due to their design, they are reworked, e.g. by embossing, in accordance with the approval holder’s specifications, by certified

embossing companies. This is subject to compliance with the relevant manufacturer’s guidelines.

The embossing company must be certified by DIN CERTCO (competent certification bodies) in accordance with DIN 74069, edition of July 1996.

(15) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for motor vehicles and their trailers.

TR No 23: Headlamps for bicycles

(1) Headlamps for bicycles are dipped-beam headlamps with the optional lighting functions of daytime running light, full beam and parking light.

(2) Headlamps must be designed so that they can be properly aligned in accordance with Section 67 StVZO.

Headlamps which are not permanently integrated into the bicycle must have an adjustment device for this purpose. The applicant must describe the correct adjustment of the headlamps in the installation and operating instructions.

In the installation and operating instructions, the user must be informed of the mounting requirements according to the Technical Requirements and the Road Traffic Approval Regulation when using adjustment devices other than the tested adjusting device.

Headlamps permanently integrated into the bicycle must be fitted with a pre-set inclination. The applicant must provide evidence that the requirements of TR No 4, Part 2(12) have been met.

(3) Headlamps must produce a clearly marked cut-off line, which should be within ± 2° horizontally and ± 0.4° vertically so that it can be used to safely adjust the headlamps on the bicycle.

Where applicable, linearity must be determined in accordance with Annex 6(4.1.) of UN Regulation No 149, 00 series of amendments, Supplement 3 with the described instrumental method. By way of derogation, scanning shall be carried out vertically from -4° to +0.5°.

For this purpose, two vertical lines must be selected so that they run through the visually highest and lowest points of the cut-off line within ±2° horizontally.

The respective inflection point of the gradient of the cut-off line at these positions is to be determined with $\frac{d^2(logE)}{dv^2}=0$.

The vertical distance of the measured turning points must not exceed 0.8°.

(4) For the test, the headlamp is aligned by means of a measuring screen on which the lines H-H (dividing line) and V-V as well as the point HV are indicated. (see Figure 4 of ISO 6742-1:2015[2])

The measuring screen (the test surface) must be positioned at a distance of 10 m in front of the headlamp so that it is perpendicular to the line joining the headlamp light source and the centre mark, and that the dividing line is horizontal.

In the horizontal direction, the headlamp must be adjusted so that the light distribution is as symmetrical as possible in relation to the vertical through the central mark.

[2] ISO 6742-1:2015-05
Cycles – Lighting and retroreflective devices – Part 1: Light fitting

In the vertical direction, the headlamp must be adjusted so that the cut-off line runs parallel to or on the dividing line.

(5) Dipped-beam headlamps for bicycles must

- meet the photometric requirements set out in point 4.5.1. of ISO 6742-1:2015.
- For the photometric measurements, the dipped-beam headlamps and the dipped-beam headlamps with daytime running light function must be operated in accordance with TR No 3, Part 3(4), (5) and (6)
- in the case of alternating voltage-operated headlamps, generate light at 3.6 V at the latest.
- In addition, the luminous intensity of 200 cd must not be exceeded in any direction above the horizontal.
- In addition, the maximum luminous intensity is limited to 0.25 cd in the horizontal angular range from ± 165° to ± 180° and vertically to the rear of the vehicle from -2,5° to + 5°.

(6) Headlamps forming a pair, which are to be used only in pairs, must meet the requirements of paragraph 5, with each individual headlamp fulfilling at least the requirements for the 10 lx light distribution for the right-hand and left-hand side, respectively, 0° inwards and 4° outwards based on Figure 4 in point 4.5.1. of ISO 6742-1: 2015.

The headlamp for mounting on the right side must be marked with the letter ‘R’ and the headlamp for mounting on the left side with the letter ‘L’. Headlamps forming a pair are regarded as a single headlamp. Appropriate instructions for correct installation and adjustment must be included in the installation instructions.

(7) The following lighting functions may optionally be integrated in or combined with the dipped-beam headlamp:

- A daytime running light function which, in accordance with the requirements of Section 67 StVZO, must comply with either the minimum luminous intensity or light distribution specified in UN Regulation No 87, 00 series of amendments, Supplement 7, or UN Regulation No 148, 00 series of amendments, Supplement 3, point 5.4., or the light distribution with the minimum luminous intensities set out in the following table.

	Minimum luminous intensity in cd				
Angle	H = -10°	H = -5°	H = 0°	H = 5°	H = 10°
V = 10°	-	80	80	80	-
V = 5°	40	-	280	-	40
V = 0°	100	360	400	360	100

Table 12

The specified maximum of 1 200 cd must not be exceeded above the H-H line.

The deactivation of the daytime running light function must be automatic and coincide with the activation of the dipped-beam headlamp. To this end, the conditions based on Annex 13 to UN Regulation No 48, 07 series of amendments, Supplement 1 must be observed.

The daytime running light must be deactivated automatically within 2 seconds if the ambient brightness is below 1 000 lx. Deactivation may take place between 1 000 lx and 7 000 lx at the discretion of the manufacturer. To this end, the conditions based on Annex 13 to UN Regulation No 48, 07 series of amendments, Supplement 1 must be observed.

- A full-beam function that can be activated and deactivated by an operating device, and has a blue function indicator light with the required symbol. The required symbol may also be placed next to the function indicator light. The position of the operating devices for the activation of the full-beam function, the function indicator light and the required symbol must comply with UN Regulation No 60, 00 series of amendments, Supplement 4. The function indicator light must be within the field of vision of the driver looking forwards, which must be indicated in the installation and operating instructions.

  The illuminance generated on the measuring screen must comply with the requirements of ISO 6742-1:2015, point 4.6.

  For photometric measurements of the full-beam function, the headlamp must be operated as specified by the manufacturer.

  The current measured during the test must be documented in the measurement report.

  If applicable, the operating manual must indicate that this full-beam function must only be operated in conjunction with a bicycle dynamo that provides sufficient power.

- - A parking light function whose luminous intensity must be at least 4 cd after 4 minutes of illumination at measuring point A in accordance with ISO 6742-1:2015 point 4.5. based on a fully charged energy storage device.

(8) The colour of the emitted light is white.

(9) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for bicycles and bicycle trailers.

TR No 24: Bicycle dynamos

(1) Bicycle dynamos for bicycles and their trailers must provide at least 1.5 W and meet the requirements of ISO 6742-4:2015[3] point 4.2.3. By way of derogation, the voltage may exceed 7.5 V. For this purpose, the tests are carried out with an electronic load in accordance with Annex A to ISO 6742-4:2015 and the resistors R3 and R4 in the circuit must each be replaced by 12 ohm resistors.

(2) By way of derogation from the requirements of ISO 6742-4:2015, point 4.2., 3 W generators may be tested at the request of the applicant with an electronic load in accordance with Annex A to ISO 6742-4:2015. For this purpose, the resistors R3 and R4 in the circuit must be 6 ohm resistors. The conditions are fulfilled if the test values in the following table are met:

Generator	System	Speed in km/h			Efficien-cy
force-fit or interlocking	6V 3W with electronic load	15	≥ 5	15 ≤ 30	See Paragraph (3):
		≥ 2.8 W	≥ 0.4 W	≥ 2.8 W	

Table 13

For dynamos with an output greater than 4 W, the manufacturer may make a suitable electronic load permanently available to the technical service. The requirements of the 3 W dynamo must be complied with.

(3) By way of derogation from the requirements set out in Table 1 of ISO 6742-4:2015, point 4.2.3.1., at least the energy conversion efficiencies given in the following table must be achieved at 15 km/h:

Type of dynamo	**Power efficiency**
Force-fit dynamos	**≥ 30**
Interlocking dynamos and other dynamos	**≥ 50**

Table 14

(4) Other dynamos according to TR No 3, Part 3(1) must be regarded as dynamos coupled to the hub.

The applicant must

- specify the suitable rims or wheels; and

[3] ISO 6742-4:2015-05
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- specify the distance between rim or magnet and transducer permitted by the design, or the fixed mounting position(s) and condition(s).
- provide a wheel with suitable rim or magnets. If the applicant intends to use several rims or wheels of different shapes or materials, the requirements must be met by all of them.
- In the case of one or more fixed mounting position(s) and condition(s), the tests must be carried out for all possible mounting positions or with the minimum and maximum distance between stator and rim or magnet.
- The rims to be used and the fixed mounting position(s) and condition(s) must be recorded in the measurement report, and appropriate instructions for correct installation and adjustment must be included in the installation instructions.
- These dynamos must meet the conditions laid down in paragraphs 1 to 4.

(5) In the case of dynamos which are inseparably combined with the lighting device, the tests referred to in paragraph 1 must be carried out with the lighting device as a load. These combinations with more than 1.3 W power at the speed specified in paragraph 3 must comply with the energy conversion efficiency required therein.

In addition, the current for supplying the lighting device must be determined at 5 km/h and 15 km/h so that the test can be performed in accordance with the relevant TR for the lighting device.

The lighting device must then:

- comply with the required conditions at the current determined at 15 km/h, and
- fulfil 1/10 of the required conditions in the maximum light distribution at the current determined at 5 km/h.

(6) In the case of hub dynamos, a frequency of alternating voltage of at least 6 Hz at the maximum external diameter of the wheel and at a speed of 5 km/h is permissible.

(7) The following information must be clearly legible and permanently marked on each dynamo:

a. the test mark

b. the maximum power and maximum voltage at 15 km/h

c. for dynamos whose speed is dependent on the wheel diameter, the range of permitted wheel diameters (in mm) for which the required conditions are met.

(8) In the case of dynamos that deliver a higher voltage than 7.5 V under load at 15 km/h, the operating instructions must indicate that they may only be operated in conjunction with bicycle headlamps that have a separate voltage output limited to 7.5 V for the rear light.

(9) TR numbers 2 to 5 shall also apply to the design and testing in so far as they apply to lighting devices for bicycles and bicycle trailers.

TR No 25: System for automatic alignment of headlamps for bicycles in bends

(1) An automatic headlamp alignment system must be designed in such a way that, when activated, it always equalises the cut-off line horizontally around the rolling axis of the bicycle in accordance with TR No 4, Part 2(12).

(2) An automatic headlamp alignment system may only be used for headlamps designed for bicycles in accordance with TR No 23 and, where applicable, combined with a retroreflector in accordance with TR No 18.

(3) The following assessments must be carried out by means of a validation ride with video documentation and on the goniophotometer, simulating typical parameters for bicycle geometry and driving dynamics parameters (wheelbase, roll angle, steering angle, lowering, etc.).

(a) From a speed of 5 km/h, the roll of the vehicle must be compensated for with a roll angle of the longitudinal median plane of the vehicle of ± 15. At a speed below 5 km/h, the system may operate as described above or position the headlamp in neutral position. In the neutral position, the optical axis of the headlamp must be parallel to the longitudinal median plane of the vehicle.

(b) The control speed of the system must not exceed 0.5 seconds and the deviation between the target and the actual value must not exceed 7° at any time.

(c) When the vehicle is stationary, the system should be ready for operation at the latest 4 seconds after activation and must align the cut-off line horizontally around the rolling axis of the bicycle in accordance with TR No 4, Part 2(12). When the vehicle is not stationary and is travelling in a straight line on a level surface, the alignment must take place no later than 8 seconds after activation.

(d) When the system is activated in any inclined position, it must align the cut-off line horizontally around the rolling axis of the bicycle in accordance with TR No 4 Part 2(12) as soon as it is ready for operation and enters the intended rolling angle range.

(e) The system may include functions for headlamp range adjustment in bends and cornering lights. The functions must be assessed in such a way that, with a roll angle of > 0° (to the right and left), the level of the cut-off line is not higher than in the initial position (roll angle = 0°) and remains aligned horizontally around the rolling axis of the bicycle when lighting into the bend.

(f) The system must not impair the photometric performance of the dipped-beam headlamp to be adjusted.

(4) The manufacturer must specify in the operating manual how the permissible headlamps may be dimensioned (dimensions and mass) and the installation points to be used. Furthermore, the intended range of the roll angle to be compensated must be specified and it must be pointed out that a mechanical blockage of the system, including headlamps, in this range must be ruled out.

(5) The stability and strength must be verified in accordance with TR No 5(5). This must be checked in each case with the maximum permissible headlamps as specified by the manufacturer.

(6) In the deactivated state, the system must be locked in the neutral position. If the system can be activated and deactivated simultaneously with the headlamp, this locking is optional.

(7) By way of derogation from TR No 4, Part 1(1), and TR No 4, Part 2(3), the position of headlamps mounted with an appropriate system may be adjusted in such a way that the horizontal orientation around the rolling axis remains horizontal and the headlamp range does not change.

(8) Operability must be ensured for the entire voltage range specified by the manufacturer in the operating instructions. The maximum voltage must not exceed 50 V.

(9) The electrical supply of the system must be independent of the headlamp.

If this is not the case, the vehicle's electrical power supply system must be sufficient to ensure that the photometric performance of the lighting devices operated simultaneously with it are not impaired. In the second case, the manufacturer must indicate in his operating instructions that the system may only be used if the amount of energy provided by the electrical supply system is sufficient.

(10) In the event of a failure in the electrical power supply to the system, the headlamp setting must be capable of returning to the neutral position independently or it must be possible to return it mechanically to that neutral position. A corresponding information must be included in the operating instructions.

(11) TR numbers 2 to 5 shall apply to the design and testing in so far as they apply to automatic headlamp alignment systems.

(12) If an automatic headlamp alignment system can only be operated with one voltage type, it must be labelled with the respective symbol for operation with direct voltage or for operation with alternating voltage in accordance with TR No 4, Part 2.

(13) If the system includes voltage-limiting devices, it must be labelled in accordance with TR No 4, Part 2.